AK-CHIN INDIAN COMMUNITY BIOMASS FEASIBILITY STUDY

Department of Energy

Office of Energy Efficiency and Renewable Energy

TRIBAL ENERGY PROGRAM

FY2005 Program Review Meeting

Feasibility Study for

Renewable Energy Development on Community Lands

Solicitation # DE-PS36-02GO92006

October 19, 2005

Topics

- **Ak-Chin Indian Community**
- **Project Background and Objectives**
- **Project Description and Diagram**
- **Items Reviewed**
- **Resource Assessment**
- **Proposed Digester Technology**
- **Recommendation**
- **Next Steps**
- **Contact Information**

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Ak-Chin Indian Community

- Federally recognized Indian Tribe, founded in 1912
- Reservation approximately 22,000 acres, with about 16,000 acres cultivated by the Ak-Chin Farm
- Community has approximately 670 enrolled members of which about 75% live on the Reservation
- Employs almost 1,000 people in 3 Community-owned businesses and government
- Located approximately 30 miles southeast of Phoenix, Arizona
- There is a 100-acre industrial park
- Hickman's Egg Ranch is located in the industrial park
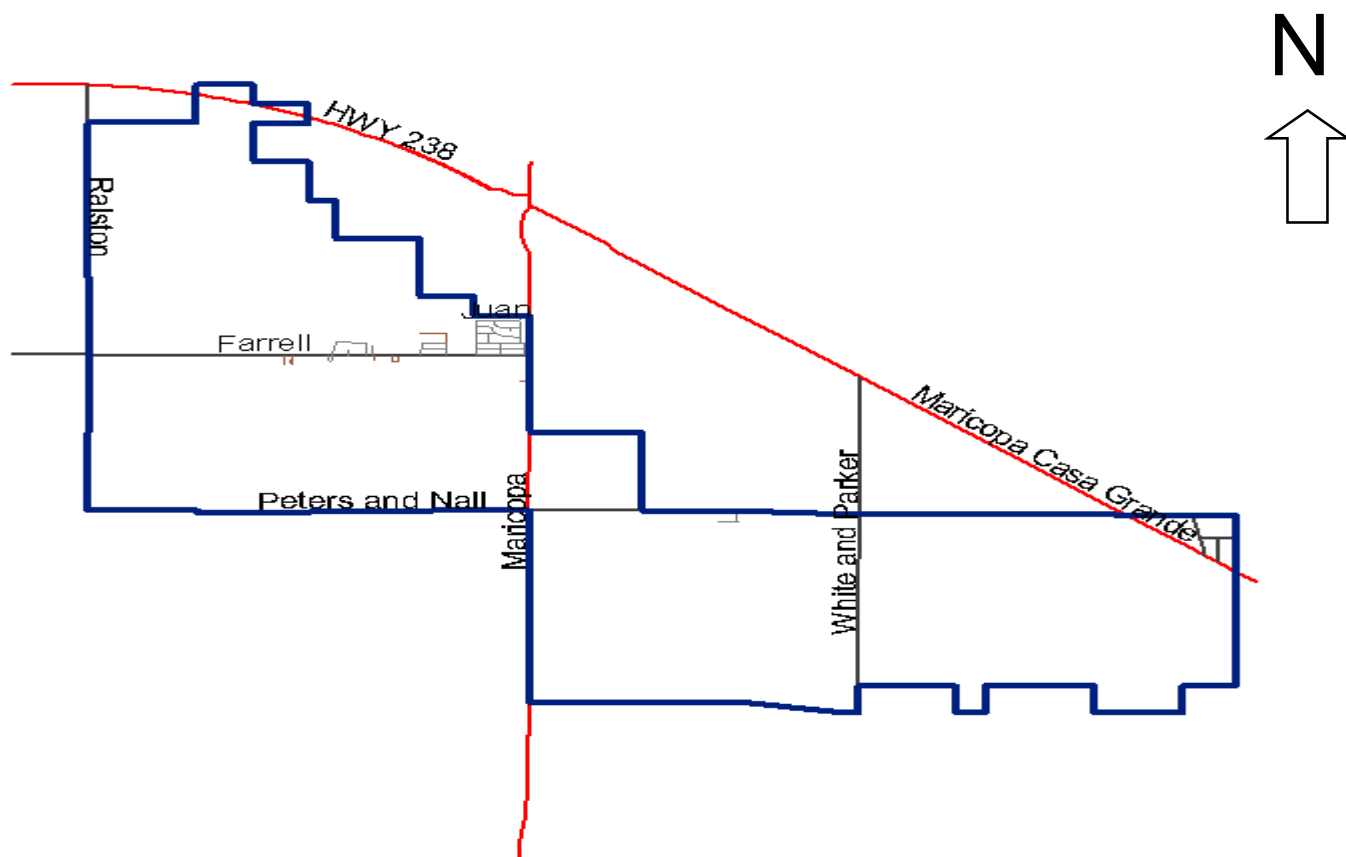- Committed to long-term self sufficiency

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Ak-Chin Indian Community Reservation

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Project Background & Objectives

- **Background**
  - Ak-Chin Energy Services (ACES), an enterprise of the Ak-Chin Indian Community, has a need for additional electrical power.
  - The Ak-Chin Farms, an enterprise of the Ak-Chin Indian Community, uses chicken litter from the Hickman's Egg Ranch as fertilizer for its agricultural crops.
  - The Ak-Chin Indian Community supports the use and/or development of cost-effective renewable energy.

- **Objective**
  - Use the chicken litter and other biomass materials to either produce bio-gas or burn and generate electricity.
  - **<u>Ensure that the Ak-Chin Farms experiences no adverse economic or nutrient dispersement impact</u>**.
  - Eliminate possible odor and fly problems.
  - Meet all environmental requirements.

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Community Compatibility

- Eliminates odor and flies issues associated with raw chicken litter
- Creates jobs
- Renewable energy source to meet Community power needs
- Water quality / nitrate issues
  - Digestion converts nitrogen to ammonium such that ammonium ions in the digester effluent can bind to soil particles while unprocessed nitrogen ions from raw manure do not.
  - Nitrogen ions are also very soluable in water making nitrogen subject to leaching thru the soil into groundwater or running off fields during periods of rainfall while ammonium ion do not..
- Dollars paid by ACES for purchase power will be retained in the Community creating the jobs associated with the project and stability in future power costs.

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Project Description
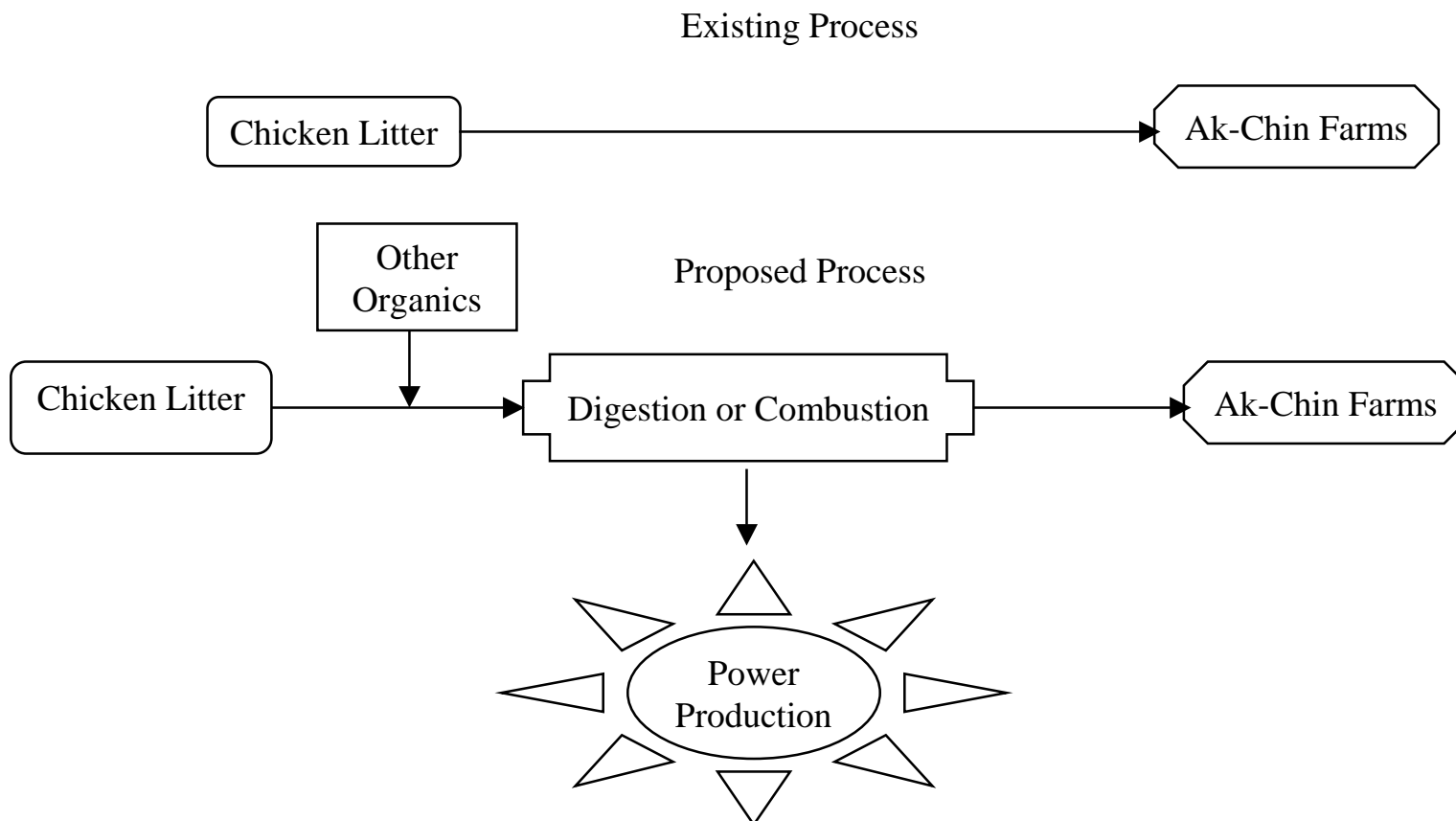
- Study use of chicken litter to produce energy either through digestion or combustion.

- Determine chemical content of chicken litter.

- Identify raw chicken litter nutrient content as used by Ak-Chins Farms.

- Identify nutrients remaining after digestion or combustion.

- Identify power production capabilities from digestion or burning that fit with ACES operational needs.

- Identify resultant fertilizer distribution system.

- Determine economic and non-economic Benefit / Cost of digestion or combustion.

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Project Concept Diagram

Existing Process

| Chicken Litter | ⟶ | Ak-Chin Farms |

Other Organics

Proposed Process

| Chicken Litter | ⟶ | Digestion or Combustion | ⟶ | Ak-Chin Farms |

Power Production

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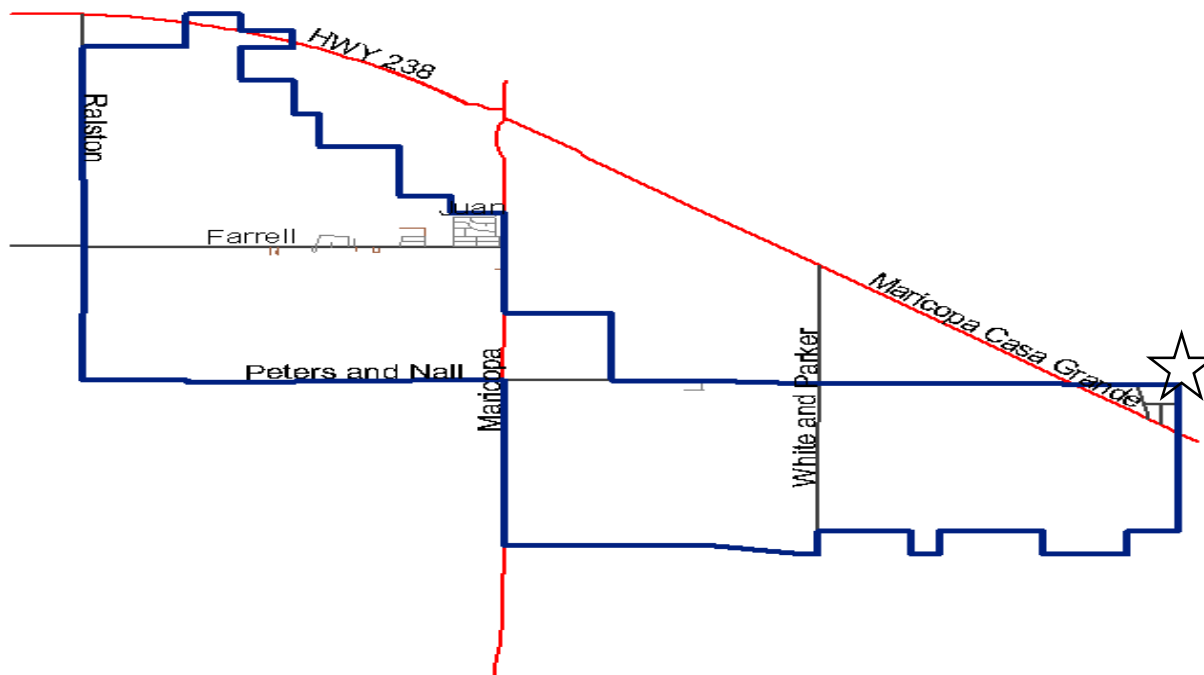
Resource Assessment – Chicken Litter

- 1.5 Million Birds

- 100 tons per day of chicken litter

- Need between 30,000 - 90,000 gallons dilution water per day

- Digester output 300,000 gpd liquid effluent

- Enough bio-gas for the production of approximately 1MW of electrical power

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Items Reviewed

- Test Chicken Litter
  - Dry BTU Content
  - Wet Digestibility
  - Nutrient Values
  - Combustion Content
- Technology review
- Power production strategy
- Nutrient distribution
- Community compatibility
- Project construction costs and financing

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Chicken Litter Test

- Digestion
  - Dry BTU Content
  - Wet Digestibility
  - Nutrient Value

- Gasification
  - Energy Values
  - Moisture Content
  - Chemical Composition of Residual Ash

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Technology Review

- **Digester**
  - Heated anaerobic digestion so as not to be subject to seasonal weather impacts
  - Produces bio-gas (Biological process producing Methane and CO_2)
  - Reduces environmental impact of chicken litter
  - Minimal effect on the nutrient content of the digested chicken litter, with half or more of the organic nitrogen (Org-N) being mineralized to ammonia (NH_3-N) thereby enhancing the ability of growing plants to utilize the nitrogen.
  - Homogeneous nutrient balanced liquid fertilizer output

- **Gasifier**
  - Gasification of carbon-based feedstock without introduction of air or oxygen
  - Benign ash
  - Produces syn-gas (Coking process producing Methane, Hydrogen, CO, and CO_2)
  - Negligible emissions
  - No nitrogen left in ash
  - Not enough feedstock available

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Nutrient Distribution Strategy

Current	Proposed
Truck hauls raw chicken litter to fields	Tanker truck hauls liquid fertilizer to fields
Truck spreads raw chicken litter on fields	Tanker truck transfers liquid fertilizer from tanker to feeder tractor and liquid fertilizer inject below soil
Tractor disks raw chicken litter into soil	Tractor disks soil
Nutrient content of raw chicken litter varies from barn to barn	Nutrient content of liquid fertilizer is homogenous
	Reduction of nitrogen loss

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Financial Analysis For Digester

- Debt – Equity Ratio – 80 – 20
- Project Life – 20 years
- Interest Rate – 6%
- Digester Capital Cost - $4.6 million
- Project O&M – 0.015 $/kWh
- Delivery System Capital Cost - $342,000
- Electrical Interconnection Cost - $100,000
- Energy Output Value At Busbar– 0.065 $/kWh
- Generator Size – 1,000 kW
- Energy Output – 7,884,000 kWhs (at 90% capacity factor)
- Green credits - 0.010 $/kWh
- Payback – approximately 10 – 12 years
- Internal Rate of Return – greater than 12%, without grant and 100% ownership by Community

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Recommendation

- ## Digestion, because:
  - Will Reduce of Odors, Pathogens & Flies
  - Nutrient content will be maintained and will provide a homogenous liquid fertilizer with consistent levels of nutrients
  - Trucking solution to distribute and apply liquid fertilizer, is similar to current practice of spreading chicken litter
  - Will produce approximately 1 MW of electrical power, helping to meet ACES' power supply needs
  - Proximity of Biomass Sources
  - Compatible with cultural resources & environment
  - Ak-Chin Farms does not have to alter cropping patterns
  - Existing utilities are close to site, making interconnection more cost effective
  - Good road access

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Proposed Digester Technology

- Heated Complete Mix Tank

- Effluent storage pond or tanks

- Site requires about 3 – 5 acres total area

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Martin Machine

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Next Steps

- Review final results with Community Council
- Obtain Community Council to proceed to implementation phase.
- Proceed with the due diligence review of design & engineering costs
- Establish financing arrangements
- Apply for grants
- Obtain contracts for equipment purchases, engineering and design, construction and green credits
- Obtain approval for site
- Begin construction, if approved by Community Council

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Contact Information

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